

# Performance of Modified Rubber Aggregate Concrete with GGBS and Silica



Sulagno Banerjee, Aritra Mandal, Jessy Rooby

**ABSTRACT** -Transfer of tyre rubber suit a tremendous difficulty in India step by step. Analysts are attempting to utilize waste rubber in structural building venture from numerous days back. When coarse aggregate was replaced with 20% chipped rubber it was found that the optimum replacement is 5% but still there is a deficit in some strength from conventional concrete. This research programme tries to minimise this gap by adding extra 5% micro silica of the weight of cement and also by replacing 40% of cement by GGBS. Here cubes, cylinders, and prisms were casted to test compressive strength, tensile strength, flexural strength, and durability against heat and were observed after 28 days and 56 days.

**Keywords:** Tyre, Rubberized Concrete, Replacement of coarse aggregate by used rubber, ggbs concrete, chipped rubber concrete

## I. INTRODUCTION

Presently sustainability is the fundamental factor for research. For environment impact researchers had tried to use waste products as much as they can and reusing of waste item is the primary key for research. In this specific research program waste tyre chipped rubber is reused as coarse aggregate which goes about as 5% substitution of ordinary coarse aggregate. For being more eco friendly 40% cement is replaced by ggbs and additional 5% micro silica is being added to improve the strength.

## II. OBJECTIVE & PAST RESEARCH

Concrete is the most utilized material in development obligated for the consumption of regular assets and builds the shortage of the fixings, for example, cement, steel and aggregates, thusly there is an interest for these materials in the business part. Further mining of waterway sand causes extreme ecological harm by bringing down ground water table and breaking down of shake strata causes avalanche and seismic tremor. Architects are on edge to conquer this issue with different choices. Numerous scientists have endeavored to recognize the backup utilization of the conventional materials. Emiroglu et al [1] discovered Slump relies upon rubber substance and progressive diminishing in quality with the expansion of rubber.

Gammel et al [2] tried concrete with 10% - 25% crumb rubber supplanting alongside Silica fume and Rubcrete. Helme et al [3] prescribed 25% substitution demonstrated compressive quality inside admissible range for most utilizations of concrete of the control blend plan. Naito et al [4] discovered unit weight of C R C diminishes linearly. Richardson et al [5] discovered concrete strength reduction means that air void/crumb separating which offers freeze / thaw resistance. Naik et al [6] found that it is conceivable to make moderately high quality rubber concrete utilizing magnesium oxychloride cement, which gives better holding attributes to rubber and altogether improves the presentation of rubcrete. Senthilet al [7] discovered evaluation of grade of concrete assumes the real job in the ductility performance of rubber replaced concrete.

## III. EXPERIMENTAL INVESTIGATION

### A. Materials used

#### A.1. Cement and Aggregates

For making the concrete, Ordinary Portland Cement of grade 43, confirming to IS: 8112-1989[8] was used. As per IS: 383-1970[9] natural river sand was categorized under grading zone I and was used as fine aggregate. Coarse aggregate was passed through 80mm sieve and retained on 4.75mm sieve confirming IS: 383-1970[9] was used for concreting.

#### A.2. Water

For mixing and curing of concrete clean potable water is used.

#### A.3. Rubber aggregate

In this study 5% of coarse aggregate is replaced by this chipped rubber (Pic1). 40 mm is the maximum size of the TDA (Tyre Derived Aggregate).



Pic1. Rubber aggregate

#### A.4. GGBS

GGBS which is near white in colour is a high quality product, manufactured from a by-product of the steel or iron making industry. In this study 40% of cement is replaced by ggbs.

Revised Manuscript Received on December 30, 2019.

\* Correspondence Author

**Sulagno Banerjee\***, Research Scholar of Civil Engineering Department, Hindustan University, Padur, Chennai, Tamil Nadu, India & Assistant Professor, Civil Engineering Department, Elite College Of Engineering, Sodepur, Kolkata, India

**Aritra Mandal**, Research Scholar of Civil Engineering Department, Hindustan University, Padur, Chennai, Tamil Nadu, India & Assistant Professor, Department of Civil Engineering, Techno International Batanagar, West Bengal, India

**Dr. Jessy rooby**, Professor, Civil Engineering Department, Hindustan University, Padur, Chennai, Tamil Nadu, India

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an open access article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

## Performance of Modified Rubber Aggregate Concrete with GGBS and Silica

The physical properties of GGBS sample is shown in Table1:

**Table 1. GGBS Properties**

Sl.NO	CHARACTERISTICS	VALUE
1	Specific Gravity	2.90
2	Bulk Density (kg/m <sup>3</sup> )	1220
3	Surface Area (m <sup>2</sup> /kg)	416
4	Insoluble Residue (%)	0.14
5	Moisture Content (%)	0.14
6	Loss On Ignition (%)	0.19

### A.5.Glenium 51

For higher workability, Glenium superplasticizer (Pic2) is used as 0.5% of cementitious material.

### A.6.Micro Silica

The specific gravity of microsilica is 2.63. It is odourless white coloured powder with a pack density of 0.76 gm/cc. In this study micro silica as 5% by weight of cement is being extra added.

## IV. MIX DESIGN (AS PER IS 10262 – 2009)

As per IS 10262:2009[10] and based on the trial mixes, the final design mix for M25 grade concrete were found out to be 1:2.20:2.72. With this design mix workability test and various strength tests were performed and their results are interpreted.

## V. RESULTS

### A.1. Workability test

Slump cone apparatus (Pic2) was used to perform the slump test in order to find out the workability and it is displayed in Table 2.



**Pic 2. Workability test and superplasticizer Glenium51**

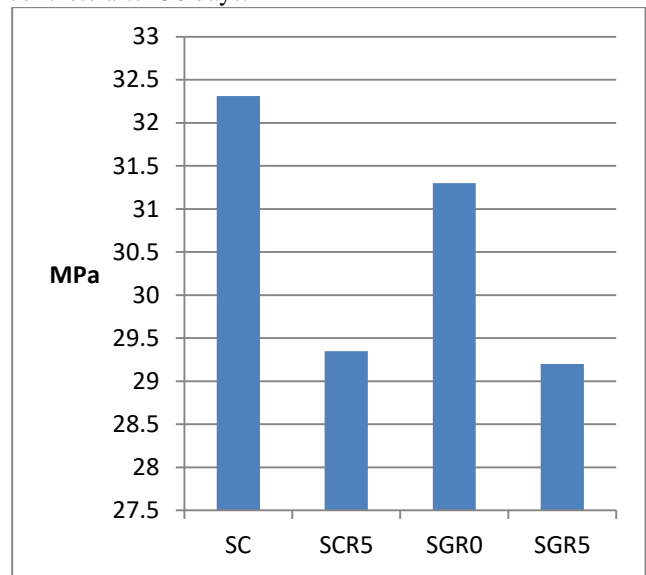
**Table 2. Workability test result**

Specification	Dosage Of Superplasticizer(% Weight Of Cement)	Slump (Mm)	W/C Ratio
Sc(Control Concrete)	0	100	0.45
Scr5(Control Concrete+5%Rubber)	0.5	90	
	0.25	85	
	0.5	95	

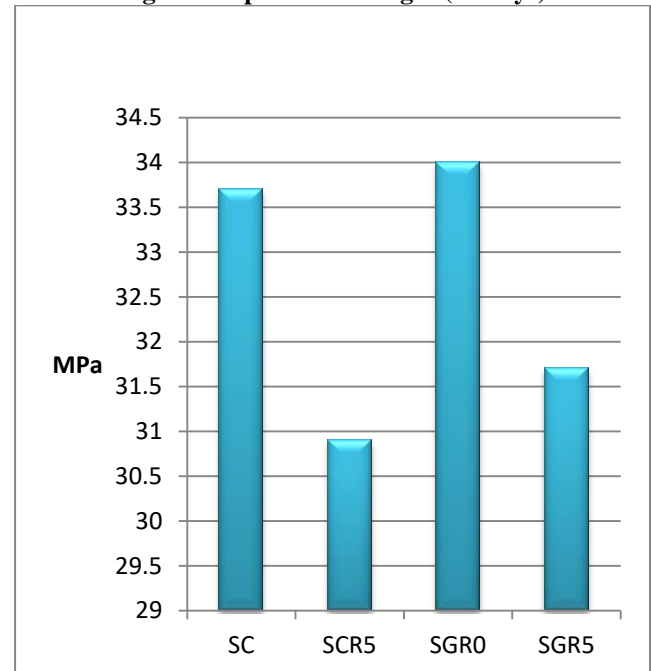
### A.2. Compressive strength

Universal testing machine was used for the determination of compressive strengths for the specimens after a curing time of 28 and 56 days respectively and they are displayed below in Fig 1 & 2. From these figures one can clearly understand that the GGBS replaced concrete with and without rubber

shows better performance after 56 days rather than after 28 days. Infact they reached the target strength after 56 days and are showing more strength than the conventional concrete after 56 days.



**Fig.1. Compressive strength (28 days)**



**Fig.2. Compressive strength (56days)**

### A.3. Split tensile strength

From the 56 days split tensile strength which is shown below in Fig 3, one can clearly understand that by adding micro silica and replacing cement with GGBs we achieved the similarity in split tensile strength of conventional concrete and rubber concrete.

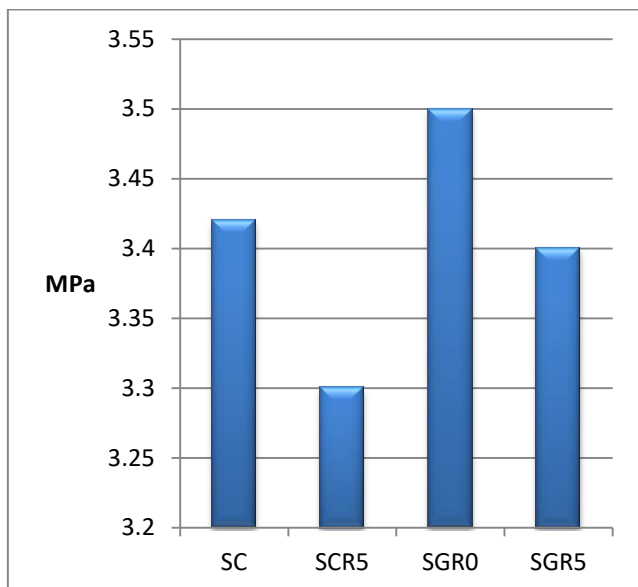


Fig.3. Split tensile strength (56days)

#### A.4. Flexural strength

From the 56 days flexural strength which is shown below in Fig 4, one can clearly understand that by adding micro silica and replacing cement with GGBs we achieved the similarity in flexural strength of conventional concrete and rubber concrete.

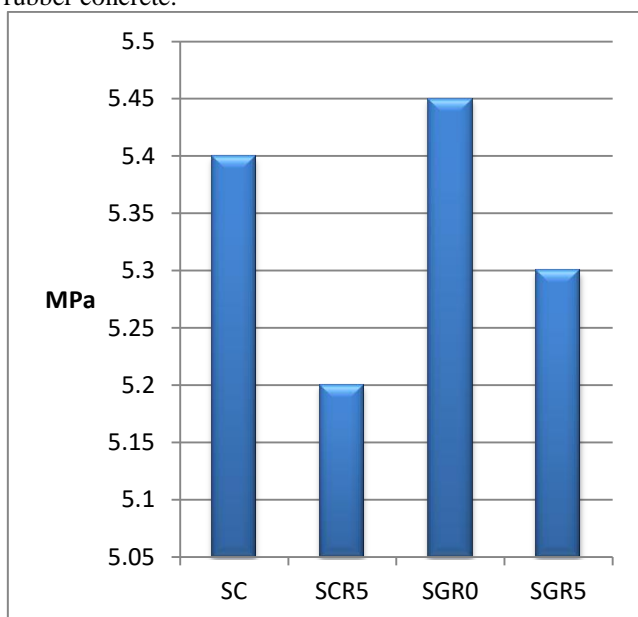


Fig.4. Flexural strength (56days)

#### A.5. Heat study

Samples in cubes and samples in cylinders are cast and after 56 days of curing in water they are dried and put into oven for 3 hrs at a temperature of 150°C. Then strength parameters like compressive and split tensile were found out and are drawn below in Fig 5 and Fig 6. From the heat study we can see the amount of decrease in compressive as well as split tensile strength in conventional concrete is same as it is in rubber aggregate replaced concrete with cement replaced GGBS and added silica.

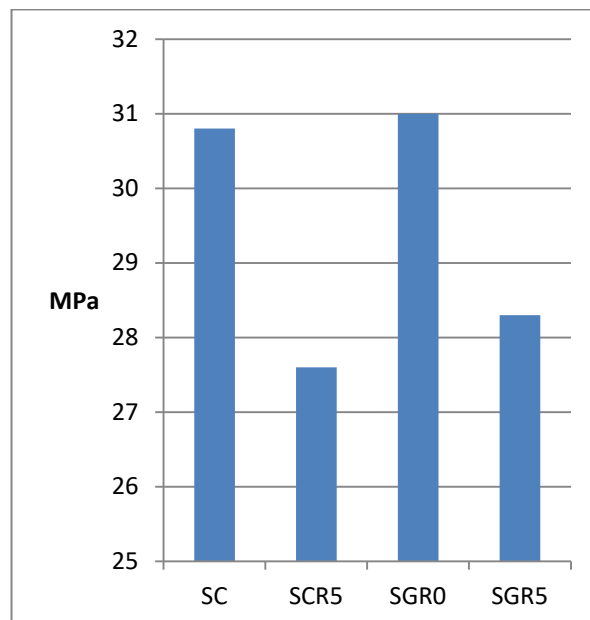


Fig.5. Compressive strength (56days) (At 150°C for 3 hrs)

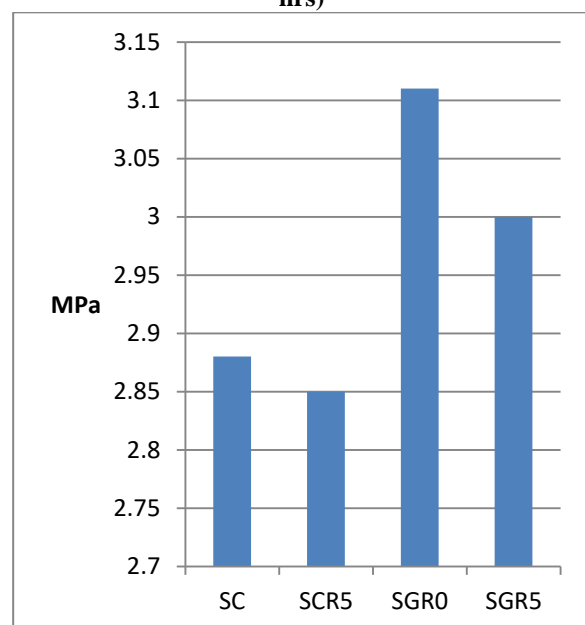


Fig.6. Split tensile strength (56days) (At 150°C for 3 hrs)

## VI. DISCUSSIONS

Microsilica in cement improves its strength and durability as it gives progressively uniform dissemination and a more noteworthy volume of hydration items and diminishes the normal size of pores in the cement paste. With the addition of rubber slump value decreases and so we have to add some superplasticizer in order to get the required slump value. The GGBS replaced concrete showed better performance after 56 days rather than 28 days. After 56 days, concrete with 5% replaced rubber aggregate shows only 5.9% decrease in compressive strength, 5.8% decrease in split tensile strength and 1.9% decrease in flexural strength. The heat study showed that rubber concrete shows almost equal heat resistance than normal concrete at 150°C for 3 hrs.

## VII. CONCLUSIONS

- By adding micro silica and replacing cement with GGBs we achieved the similarity in strength of conventional concrete and rubber concrete.
- When rubber is added the mixture becomes dry and so slump value decreases and hence we have to add superplasticizer in order to get the desired slump value.
- The GGBS replaced concrete with and without rubber shows better performance after 56 days rather than after 28 days. Infact they reached the target strength after 56 days and are showing more strength than the conventional concrete after 56 days.
- From the heat study we can see negligible amount of decrease in compressive as well as split tensile strength. So we can conclude at around 150°C for 3 hrs the rubber concrete is getting least affected.

## REFERENCES

1. M. Emiroglu.S. Yildiz O Kestemur.M.H. Kelestemur, "Bond performance of rubber particles in the self-compacting concrete" ISBN: 978 - 88 - 907078 - 3 - 4 2012 Publisher creations
2. EL Gammel,A-K Abdel, Gawad,Y- EL Sherbini,A. Shalaby,"Compressive strength of concrete utilising waste tire rubber". Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS) 1 (1): 96-99
3. Jenna Lee Helme, "Concrete, A use for use Tires "cssf projects 2010
4. ClayNaito,,M.Asce,,Joestates,,ChristopherJackson,,BryanBewick. "Assessment of crumb Rubber concrete for flexural structural member". AESC , Journal of civil engineering vol 26 issue 10
5. Alan Richard son ,KathrynCoventry,JacquesPienaan, "The potential for achieving freeze/thaw protection in concrete through addition of rubber crum" Paper's No. BUE-FISC - 2.
6. TarunNaik, RafatSiddique,"Properties of concrete containing scrap tire rubber - an overview". Report No. CBU-2002-06 REP-459 February 2002, centre for bi product utilization
7. SenthilVadivel, R. Thennozhi,"Experimental study on waste tyre rubber replaced concrete-ecofriendly construction materials". Journal of Applied Sciences Research;Jun2012, p3966
8. IS, 8112-1989 Indian Standard,of OPC 43 BIS, New Delhi
9. IS383-1970 , Indian Standard of aggregate, BIS, New Delhi
10. IS 10262-2009 Indian Standard of concrete mix design, BIS, New Delhi

## AUTHORS PROFILE



**Sulagno Banerjee**- Having almost 15 years' experience in academic and consultancy. Writer of various technical paper in so many journals, some of them are scopus indexed. Presented papers in national and international conferences. Currently holds position of associate professor in ELITTE COLLEGE OF ENGINEERING and doing PhD from Hindustan Institute of Technology and Science, Chennai.



**Aritra Mandal** – Having almost 10 years' experience in academic and consultancy. Writer of various technical paper in so many journals, some of them are scopus indexed. He presented papers in national and international conferences. Currently holds position of assistant professor in Techno India group and doing research on concrete from Hindustan Institute of Technology and Science, Chennai.



**DR. JESSY ROOBY** - Having almost 23 years' experience in academic. Writer of various technical paper in so many journals, some of them are scopus indexed. Professor and former HOD of civil engineering department, Hindustan Institute of Technology and Science.